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RELATIONSHIP OF PERSONALITY FACTORS
and
SOME SOCIAL HABITS TO CARDIOVASCULAR RISK
IN SUBMARINERS

by

D. V. Tappan and B. B. Weybrew

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W. C. Milroy, CAPT, MC, USN
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Relationship of Personality Factors and Some Social Habits to Cardiovascular Risk in Submariners

D. V. TAPPAN and B. B. WEYBREW

Naval Submarine Medical Research Laboratory, Groton, Connecticut 06349

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Correlational and contingency analytical techniques were used to investigate the relationship between subtest scores on the Minnesota Multiphasic Personality Inventory (MMPI) and coronary heart disease (CHD) risk factors in 1000 submariners. Groups of personality traits, both enhancing and protecting against risk of heart disease, were identified in these subjects. Personality trait patterns tending to be least associated with cardiovascular risk are tentatively identified by the three MMPI scales: psychasthenia, schizophrenia, and social introversion. On the other hand, the scales most strongly related to CHD risk in the submariner sample were denial of symptoms as measured by the K-scale, hypochondriasis, and hysteria. While the inherent inaccuracy in the prediction of CHD risk in young healthy individuals limits generalization from these findings, the potential utility of the MMPI to assist in risk detection is indicated. Comparisons of cigarette smoking, coffee drinking, and alcohol consumption with personality characteristics identified by the MMPI yielded trait clusters associated with each addictive habit. Cigarette smoking and alcohol consumption tended to correlate with traits positively associated with CHD risk. The correlations between these addictive habits and MMPI subtest scores were most significant for the F-scale, which measures inordinate tendencies to exaggerated emotional symptoms, and for the psychopathic deviate and hypomania scales. Significant negative correlations were found between the amount of coffee consumed and those personality traits negatively associated with CHD risk. These negative relationships were most significant for the MMPI scales schizophrenia and psychasthenia. Though the relationships were not necessarily construed to be causal, the contrasting modes through which these drug-associated habits appeared to relate to cardiovascular risk lend some support to the assumption that individuals with various specific sets of personality characteristics tend to incorporate these addictive behaviors into their behavior repertoire in very different ways.

WIDELY DIVERGENT points of view seem to be held by various investigators concerning the influence of psychological processes on the development of cardiovascular diseases. For example, the Framingham Study, sponsored by the National Institutes of Health, has compiled a list of biomedical variables and habits correlated with cardiovascular disease without particular emphasis on psychological factors (1,2). In contrast, the investigators of the Western Collaborative Group emphasized their findings that persons with the tense, ambitious, fiercely aggressive Type A personality are much more likely to develop coronary heart disease (CHD) during their life span than those with the Type B personality, who experience much less severe tension and are less obsessed with personal achievement (3-5) Since relatively few studies have considered the interaction between personality trait patterns and CHD risk, the present paper addresses this question by focusing on the trait configurations, obtained from a standardized personality test, as they relate to estimated probabilities of CHD in a population of more than 1000 active duty submariners. In addition, the social habits, coffee drinking, and alcohol consumption were compared in CHD risk to the well-documented risk factor, cigarette smoking (1).

There are several reasons for pursuing the relationship of submariners' personal living habits and their reactions to submarine stress to their propensity for certain illness patterns, such as CHD. First, with more than 100 nuclear submarines now operational—with one crew of 110 men on each attack vessel and two crews numbering 140 on each missile submarine—the "at risk" population of submariners is sizeable. First, the critical nature of the tasks performed by the men demand that their health be maintained at optimal levels for effective adaptation to the rigors of submerged missions, which often exceed 70 d. Second, the stresses imposed upon the submariner are, in many ways unique. The confinement, isolation, monotony, and boredom, as well as the exposure to a self-contained atmosphere, and the apprehension concerning the potential hazards of intense seawater pressure, are but a few of the stresses of submarine life (6).

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Additionally, being an all volunteer branch of the U.S. military, the submarine service must, of necessity, sustain a favorable image if sufficient numbers of quality men are to be attracted to and retained in this branch of the Navy. It is the intent of studies such as this to identify means for improving the quality of life for naval personnel aboard submarines as well as ashore.

A final goal of this study was to present data on the possibility that, because of the arduous and unique nature of the submarine duty, the submariner might be excessively prone to heart attack, often occurring shortly after retirement. While further epidemiologic information will be required to determine the influence of submarine duty on longevity, the authors assume that some of the related social and physical health factors considered here may illuminate the processes involved in adaptation by the nuclear submariner.

MATERIALS AND METHODS

Subjects: The data for this investigation originated as part of an epidemiological study involving extensive biomedical testing of 1015 submariners—143 officers and 872 enlisted men.* The age of the submariner sample had a mean and standard deviation of 28.4 ± 5.9 years. The enlisted segment had a mean of 12.3 ± 1.2 years of formal education while the same statistic for the officer subsample was 15.7 ± 1.6. For the enlisted men, the mean and S.D. for the distribution of verbal aptitude test scores as measured by the USN General Classification Test was 60.2 ± 7.2 standard score units. This compares to a navywide mean of 50 ± 10 units. The active duty "time-in-service" for the group was 8.9 ± 5.9 years (11).

Measurement and statistical techniques: Personality trait patterns for the submariners were obtained by means of the Minnesota Multiphasic Personality Inventory (MMPI). This personality test consists of three validity scales and 10 diagnostic scales, composed of 566 true/false items. The MMPI was selected for use in the present study for several reasons: 1) This test has been widely used in psychiatric practice as well as in other clinical, industrial, and educational situations for about 25 years in the United States and abroad; 2) Validation data for both diagnostic and a variety of predictive purposes are readily available; and 3) Many normative data on the submariner population are already in the literature (12,13).

The validity and psychodiagnostic categories evaluated by the MMPI are described and abbreviated as follows: L or lie scale, measures inordinate deceptive tendencies in responses to the test items; F-scale, tendency to exaggerate symptoms or faults; K-scale, tendency to deny faults; hypochondriasis (Hs), excessive concern about one's own health; depression (D), feelings of worthlessness or hopelessness; hysteria (Hy), use of ailments without physical basis as defenses; psychopathic deviation (Pd), tendency toward dysocial or antisocial conduct; masculinity-femininity (Mf), degree of sex role identification; paranoia (Pa), excessive suspiciousness of others; psychasthenia (Pt), compulsive acts and obsessive thoughts; schizophrenia (Sc), withdrawal trends or lack of reality contact; hypomania (Ma), irrational elation and excitement; and social introversion (Si), avoidance of social contacts.

After conversion of the data from the subtests to standard scores in T-score form,** a contingency analysis was used to examine the significance of relationships between MMPI scale scores and estimated CHD risk levels. The estimates of CHD were divided into categories above and below the median of the probability distribution; the MMPI T-scores of 50 or less were designated as low, and of more than 50 as high. For a cluster of MMPI traits to be counted as high or low for an individual subject, all of the T-scores for these traits were required to fall above or below 50. When this criterion was not met, the cluster was not counted in the data recorded in the tables.

The first hypothesis tested in this study proposed a relationship between CHD risk and the 13 MMPI subtest distributions outside a T-score range of 30-70, which is assumed by some to represent a so-called "band of normalcy" (14,15). The cells of the resulting 2×2 tables, therefore, involved the upper and lower 30% of the CHD probability distributions. However, the results of this preliminary analysis yielded somewhat less than 5% of the sample in the high (T-score >70) and low (T-score <30) MMPI categories, too small a sample for substantive statistical analysis. As a result, it was decided to opt for "splits" at the approximate medians of both the MMPI distributions and the CHD risk continum as shown in the tables presented.

CHD risk was estimated by applying the regression weights reported by Halperin, Blackwelder, and Vetter (2) to the values obtained from the 1015 submariners for the seven parameters: age, amount of cigarette smoking, relative body weight, serum cholesterol level, hemoglobin concentration, systolic blood pressure, and presence or absence of electrocardiographic abnormalities (10). Data for the alcohol and coffee consumption habits were collected along with information concerning smoking habits during the routine physical examination procedure (7,8).

RESULTS

Since definitive information relating MMPI test score patterns to Type A or B personalities is not available, we have searched for clusters of MMPI-defined trait dimensions associated with CHD risk. Data pertaining to these relationships are contained in Table I. Eight MMPI-scale categories have been hypothesized for adaptability to external stress (14-18). To evaluate the relationship between these patterns and CHD, the subjects were grouped into four categories: low risk-low MMPI, high risk-low MMPI, low risk-high MMPI, and high risk-high MMPI.

Five of the eight 2×2 contingency tables reached significance at more than the 95% confidence level. Of the

* An overall description of the measurement techniques may be found in Sawyer with Baker (7) and in Tansey (8). Summaries of the biochemical and hematologic data arising from this study have been reported by Tappan *et al* (9,10). The results of the personality testing may be found in Weybrew and Noddin (11).

** T-score distributions have an approximate mean of 50 and an S.D. of 10. The MMPI distributions in T-score form for both officers and enlisted men in this sample may be found in Weybrew and Noddin (11).

TABLE I THE RELATIONSHIP OF SELECTED MMPI PATTERNS TO CHD RISK WITHIN AGE GROUPINGS OF SUBMARINERS †

MMPI FACTORS	AGE	LOW MMPI'S N	LOW MMPI'S % HI RISK	HIGH MMPI'S N	HIGH MMPI'S % HI RISK	CHI SQUARE	DIRECTION OF RELATIONSHIP
Hs Hy D*	27-50	120	72	98	84	4.4*	+
Hs Ma	27-50	151	75	103	85	3.7	+
D Pd Pt	17-50	280	54	197	45	4.0*	
D Pt	17-50	418	56	290	42	13.5***	
D Pt F	17-50	334	56	187	42	10.2**	
Hy Pd	17-50	306	45	320	53	3.4	+
Pd Ma	17-50	166	73	121	82	3.1	+
Pa Pt Sc	17-50	304	56	224	41	10.9***	

* p< 0.05
** p< 0.01
*** p< 0.001
† See text for explanation of abbreviations for the MMPI scales

various personality patterns found to bear nonchance relationships to CHD, the most significant were associated with D/Pt, D/Pt/F, and Pa/Pt/Sc. Note that all of these correlations were negative; i.e. high MMPI scores were associated with low risk. Using the D/Pt data as an illustration, the data of the table may be interpreted as follows: of the 418 subjects with low MMPI scores on the D/Pt subtests, 56% fell into the high CHD risk category compared to 42% of the 290 men with high D/Pt scores and high CHD risk prediction. Clearly, in this instance lower CHD risk tends to be associated with higher MMPI scores and vice versa. Similarly, low Pa/Pt/Sc scale scores as well as low D/Pt/F scores are associated with an increased likelihood for CHD. Conversely, high scores on the same MMPI scales tend to relate more closely to low risk. Finally, it may be noted that while four of the MMPI score combinations contained in Table I showed a positive relationship to CDH risk (high MMPI scores associated with high risk), only one pattern, Hs/Hy/D, was statistically significant (5% level) within the 27-50 age group.

A second approach to identifying clusters of MMPI personality traits associated with differing probabilities of CHD is shown in Table II. The CHD risk data were obtained by computer sorts for all possible combinations of the MMPI subtests taken in pairs (dyads), triads, or tetrads. The left column of MMPI patterns in Table II are those that bear a positive relationship with CHD risk. For example, subjects with T-scores >50 on Hy/K, Hs/Hy/K, etc., are those that tend to show CHD probabilities above the median of the "risk" distribution. The opposite is true for the right or decreased risk columns of data.

The most frequent associations between MMPI traits and risk, as indicated by this analysis, are the negative (−) relationships with Pt, Si, and Sc. Negative relationships also exist between risk and the factors Pa, F, L, and D. Positively (+) related factors to risk are K and Hy and probably Hs and Pd. The number of entries in the two portions of Table II indicate that negative relationships between MMPI factors combinations and risk are stronger in these subjects than are the positive relationships. Additionally, none of the positively associated clusters of traits were significantly related to risk at the level of $p<0.001$. When the subjects were divided into older and younger halves of the population,

TABLE II MMPI SUBTEST PATTERNS ASSOCIATED WITH INCREASED AND DECREASED CHD RISK IN A SUBMARINER SAMPLE (N = 1015)

INCREASED RISK (p = 0.002)	DECREASED RISK (p = 0.001)	
Hs K	D Pt	Pt Sc F
Hs Hy K	Mf Pt	Pt Ma Si
Hy Pd K	Pa Pt	Pt Si F
Hy Ma K	Pt Sc	Sc Si L
Hs Hy Pd K	Pt Si	Sc Si F
Hy Pd Ma K	Pt L	Mf Pt Sc
	Pt F	D Mf Pt Si
	Sc Si	D Pt Sc Si
	Si F	D Pt Si F
	D Pt Sc	D Sc Si L
	D Pt Si	D Sc Si F
	D Sc Si	Pd Pt Sc Si
	Mf Pt Sc	Mf Pt Sc Si
	Mf Pt Si	Pa Pt Sc Si
	Mf Sc Si	Pa Pt Ma Si
	Pa Pt Sc	Pt Sc Ma Si
	Pa Pt Si	Pt Sc Si L
	Pt Sc Si	Pt Sc Si F
		Pt Ma Si F
		Sc Si L F

four trait groupings not shown in Table II were observed to be positively related to CHD risk ($p<0.002$) in the older subjects. These combinations contained the MMPI subtests K, Hs, Pd, and Ma, along with Sc and F. To summarize the findings of Table II, it is possible to obtain tentative ranking of the relationship of CHD risk to personality traits as defined by MMPI score patterns as follows, from (+) to (−): K, Hy, Hs, Pd, Ma, L, Pa, Mf, D, F, Sc, Si, and Pt. A few of the possible interpretations based on these rankings will be discussed in the following section.

It should be recalled that the overall risk estimations used throughout this study were derived from seven differentially weighted risk factors or components. The relationship between these factors and the 13 MMPI subtest distributions is examined in the data in Table III. In particular, note the positive correlations of Hs, hypochrondriasis, with the important cluster, smoking, relative weight, and cholesterol concentration. Likewise social introversion, Si, correlates negatively with age, cigarette smoking, cholesterol, and systolic blood pressure

TABLE III CORRELATION OF CARDIOVASCULAR RISK FACTORS AND MMPI SUBTEST SCORES (N = 1015)

	AGE	SMOK	REL WT	CHOL	HGB	SYS BP	ECG
K	.151***	-.033	.000	.090**	-.006	.028	.034
Hy	.012	.049	.018	.070*	.021	-.008	.009
Hs	-.034	.101**	.072*	.082**	.023	-.004	.027
Pd	.046	.160***	.038	.035	.070*	.024	-.028
Ma	-.131***	.086**	.019	.004	.038	.024	.010
F	.011	.078*	-.036	.042	.007	.018	.026
Pa	.062	.006	-.006	.016	.014	.021	-.023
Mf	.129	.025	.053	-.043	-.046	-.025	-.024
D	.094**	.015	-.047	-.025	.011	-.009	-.017
Pt	.205***	.088**	-.015	-.024	.023	-.029	-.036
Sc	.220***	.032	-.034	-.029	.019	-.014	-.034
Si	.101**	-.073*	-.057	-.075*	-.057	-.067*	-.024
Pt	.199***	.004	-.046	-.055	.004	-.025	-.034

* p .05
** p .01
*** p .001

In spite of the low absolute values of the correlation coefficients in the matrix in Table III, there are, nonetheless, various patterns requiring comment. For example, serum cholesterol levels tend to be positively related to personality traits associated with excessive use of repressive defense mechanisms as indicated by elevated scores on K, Hy, and Hs. Similarly, excessive smoking appears to be correlated with an extrovertive trait configuration as indicated by above average MMPI scores on Pd, Ma, and F and below average on D, Si, and K. While other suggestive relationships may be identified in the table, these interactive patterns must be construed only as hypothetical, requiring further empirical validation.

The data in Table IV present the Pearson Product Moment correlation coefficients between each of the habits—smoking, coffee drinking, and alcohol consumption—and the MMPI scale scores. The MMPI scores are arranged in the order of correlation with an overall estimate of risk of CHD (10). Notice that the rank correlation (Spearman's rho) yields a coefficient of 0.91 for this listing compared to the ordering proposed above from the data of Table II.

One rather obvious conclusion from the data of Table IV is that cigarette smoking and alcohol consumption tend to have similar correlation patterns with the MMPI scale scores. Coffee consumption, on the other hand, relates quite differently. The significant correlations with smoking or alcohol consumption are primarily positive correlations with those MMPI scales which are correlated positively with cardiovascular risk. There are exceptions to this, however, such as the negative correlation between alcohol use and the MMPI scale score, K, and the positive association between the Sc scores and alcohol consumption.

The correlational patterns between coffee drinking and the MMPI scale scores, on the other hand, are more consistent. That is, significant negative correlations were found solely for those MMPI scales which tended to be negatively associated with risk. The negative correlational patterns suggest that males who drink large amounts of coffee tend to obtain low scores for personality patterns measured by the test score triad, D, Pt, and Si, and other risk-attenuating combinations.

DISCUSSION

Few instances of application of MMPI testing to the study of cardiovascular patients have been reported in the medical literature. Pancheri *et al.* (19,20), however, compared the MMPI scores of heart attack patients who

TABLE IV CORRELATION OF MMPI SCALE SCORES WITH OVERALL EXTENDED CHD RISK, COFFEE, AND ALCOHOL CONSUMPTION AND CIGARETTE SMOKING IN SUBMARINERS.

	RISK	COFFEE	CIGARETTES	ALCOHOL
K	.069*	.034	-.033	-.069*
Hy	.067*	.022	.049	-.009
Hs	.064*	.026	.101**	.042
Pd	.030	.008	.160***	.155***
F	.006	.026	-.078*	-.060
Pa	.007	.011	.006	-.007
Ma	.024	.047	.086**	.127***
F	.028	.079*	.088**	.151***
D	.029	.099**	-.015	.033
Sc	.048	.130***	.032	.064*
Pt	.062*	.163***	.004	.040
Mf	.065*	.089**	-.025	-.045
Si	.071*	.075*	-.073*	-.052

* p .05
** p .01
*** p .001

did and did not improve after 7-10 d of hospitalization. The improved group of subjects showed MMPI profiles similar to the normal population except for moderate elevations on the Hs and Hy scales. The nonimproved group had significantly higher scores on 11 of the 13 MMPI scales with T-scores of 70 or above for Hs, D, and Sc. With the exception of the high Sc scores, these findings generally agree with the predicted susceptibility of the submariner population studied here, in which above-median Hs, Hy, and in certain cases, D scores correlated positively with CHD risk. According to Butcher and Clark (20), Lithuanian studies have also been performed on the relationship of MMPI traits to the occurrence of ischemic heart disease.

It is well to state emphatically that both the CHD risk distributions and the MMPI score distributions evaluated in this study are within normal limits for medically and psychologically screened males making up the submariner sample examined. Both Tappan *et al.* (10), in a discussion of the CHD risks, and Weybrew and Noddin (11), when describing the MMPI profiles of these submariners, have stressed the relatively healthy status of the population as a whole. Too, it is important to point out that the CHD risk data analyzed were calculated from beta weights determined for a different population (1,2)

While no satisfactory follow-up data on the present group of submariners nor data on cardiovascular diseases in the submariner population as a whole or in retired submariners are available, Tansey *et al.* have tabulated such information from the medical records of 885 Polaris submarine patrols (21). These records show nine cases of cardiovascular disease with an overall rate of 0.007/1000 man-days lost to this cause compared to 0.09/1000 man-days lost to respiratory diseases, the most common category of illnesses. Although the incidence rate for cardiovascular disease is unquestionably low, its documented occurrence in a very carefully screened population of young men and the relatively high rate of transfers from submarines at sea required for treatment of these cases—22% vs. 0.6% for all illnesses (21)—along with the high risk and expense associated with at-sea transfers, make a consideration of cardiovascular risk in this group significant.

In order to avoid unwarranted interpretations concerning personality characteristics associated with MMPI trait patterns, the remainder of this discussion will be limited to those MMPI scale clusters for which some clinical validation data have been published. For example, high scores for the Hs/Hy/D combination, the so-called "neurotic triad," tend to be related positively to CHD risk (Table I). Assuming this correlation would persist upon revalidation, there still remains the question of possible mechanisms involved. One possibility is that moderately elevated scores on these three MMPI scales is indicative of inadequate anxiety defense strategies, one resultant being a chronically elevated anxiety level with all its autonomic and other systemic concomitants. Taken together, these processes may predispose one to higher CHD risk. The occurrence of the Hs trait in combination with Ma may indicate the so-called cyclothymic or hot-cold personality (16). The identification of this dyad as positively associated with risk in submariners older than 27 years is consistent with the finding of Caldwell (18), who reported the Hs/Ma dyad to be one of the most frequently occurring MMPI patterns found in persons with a history of cardiovascular disease. The findings contained in Tables I and II, however, indicate that other trait combination might be more valid predictors of CHD risk susceptibility, as well as of resistance.

Both the Hy/Pd and Pd/Ma trait pairs (Table I), which show weak positive relationships with risk, seem to represent characteristics associated with Type A personality (5). The Hy/Pd combination indicates considerable emotional instability with the possibility of social aggression (15). It has been proposed, however, that aggressive or dyssocial behavior, Pd, will be controlled to the extent of the coexistence of the Hy characteristic (22). The Pd/Ma dyad, usually considered indicative of some type of character pathology, has been shown in a male VA Hospital sample to be typical of moody, irritable persons with low frustration tolerance (17). This pattern was previously reported to exist in 5.4% of the enlisted men of the present sample but in a negligible number of officers (11). Although neither of the above patterns is among the most significant correlates of risk in the submariner sample (Table II), both MMPI dyads relate positively to risk at a confidence level approaching statistical significance.

Turning now to the negative relationships of MMPI score patterns to CHD risk, it may be seen in Tables I and II that D/Pt, D/Pt/F, and Pa/Pt/Sc appear to be the most significant. At the outset, it should be stated categorically that the negative relationship between D/Pt and CHD risk (i.e. high MMPI scores associated with low risk) is paradoxical, at least to the extent that the Type A, Type B dichotomy is valid (5). Most D/Pt people are chronically anxious, and depressed, often agitated, and obsessed about their problems. More often than not these persons, approximately 9% of the submariner population (11), are ambitious high-achievers tending to fit the type A more than the type B personality pattern. In short, these findings in Tables I and II appear inconsistent with the current literature dealing with D/Pt dyad (17). One reason for this inconsistency probably is the choice of the MMPI cut-off point used to define "high" and "low" scores. As indicted earlier, T-scores >70 and <30 characteristically define high and low classifications, respectively, whereas the same categories were specified as above and below T-scores of 50 in this study.

The MMPI pattern of paranoia/schziophrenia, Pa/Sc, if the scores are very high (T-scores >70), suggests early psychopathology, the major symptom being exaggerated suspicion, often with some delusional thinking (14-16). The addition of high scores on psychasthenia, Pt, generally tends to moderate the pathology somewhat. The fact that above-mean scores on Pa, Sc, and Pt in the present study tended to be negatively related to CHD may suggest some kind of protective or environmental insulating mechanisms for this type of personality. This notion is largely speculative, however, and requires additional validation.

Considerable agreement seems to exist between the studies on the present subjects and studies of other workers regarding the positive association of the three

oral gratification habits (smoking, coffee, and alcohol) with cardiovascular diseases (2,23). However, except for cigarette smoking, there is by no means a consensus concerning the causal relationships between the habits and the diseases. While convincing arguments have been raised linking coffee drinking directly with cardiovascular diseases (24,25), this relationship has recently been attributed by several workers to the direct association that exists between coffee drinking and cigarette smoking (26-28). In fact, preliminary evidence suggests that the incidence of fatal myocardial infarction as well as susceptibility to ventricular arrhythmias may be reduced by chronic coffee consumption (29).

Excessive alcohol consumption over long periods of time appears to adversely affect the condition and function of heart tissue (23). On the other hand, recent evidence suggests that alcohol usage in moderate amounts may reduce the risk of nonfatal myocardial infarction or death from coronary heart disease (27,30). One possible explanation for such an effect may reside in alteration in serum lipoprotein concentrations. High-density lipoprotein levels appear to increase when limited quantities of alcohol are consumed (27,31,32), although other lipid fractions, including triglycerides and very-low-density lipoproteins, have been reported to rise under similar conditions (23,31,33). Additional studies are obviously needed for resolving questions concerning the ultimate effects of alcohol consumption on CHD.

It seems important to the study of cardiovascular risk, as well as to considerations of interactions between consumption habits and personality structure, that character pathologies, largely defined by aggressive, antisocial lifestyles, appear to be associated with smoking and alcohol consumption as well as to apparent cardiovascular risk. The negative relationship between coffee drinking and trait patterns consisting of depression, social withdrawal and fragile reality contact may conceivably be more pertinent to submariners—one-third of whom, in this sample, consumed 7-14 cups of coffee/d (10)—than to American men in general. The mean and S.D.s of usage distributions for cigarette, alcohol, and coffee for this group taken in the same order were: 0.89 ± 0.9 packs/d, 14.4 ± 17.6 drinks/week, and 4.8 ± 4.3 cups/d (10).

The isolation, boredom, or monotony of duty aboard nuclear submarines characteristic of the 60- to 80-d submerged missions necessitate continuous effort on the part of the crewmembers to maintain a wartime level of vigilance and readiness for action. Such unique stressors of the submarine environment may be contributory to the submariners' exaggerated dependence upon coffee, alcohol, and cigarettes, and possibly to some unusual food preferences documented in the submarine literature but not considered in the present study (34). On the other hand, it is equally plausible that the submarine life with its dichotomies may, in fact, serve as a very useful model for simulation of some of the conflicting demands of modern living.

To reiterate the major limitations of this study, the data were obtained from a very select group of men. Further, the probabilities used as indices of CHD risk were assigned to the subject sample by regression equations, the weights for which were obtained from the existing literature. Thus, the study is correlational in nature and, as a result, implications of causality are problematical. However, the identification of the interrelationships of MMPI score patterns and lifestyle characteristics may constitute at least a first step toward predicting, and possibly controlling, the risk of cardiovascular diseases.

It would be useful for the validation of the data presented in this and earlier reports (9,10) to be able to obtain follow-up morbidity/mortality information on the subjects of these studies. Correlational comparisons of MMPI scale scores with endocrine responses to stress in submarines should also be conducted to supplement currently available information on the adaptation of these men to their uniquely stressful environment.

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Correlational and contingency analytical techniques were used to investigate the relationship between subtest scores on the Minnesota Multiphasic Personality Inventory (MMPI) and coronary heart disease (CHD) risk factors in 1000 submariners. Groups or personality traits, both enhancing and protecting against risk of heart disease, were identified in these subjects. Personality trait patterns tending to be least associated with cardiovascular risk are tentatively identified by the three MMPI scales: psychasthenia, schizophrenia, and social introversion. On the other hand, the scales most

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strongly related to CHD risk in the submariner sample were denial of symptoms as measured by the K-scale, hypochondrias, and hysteria. While the inherent inaccuracy in the prediction of CHD risk in young healthy individuals limits generalization from these findings, the potential utility of the MMPI to assist in risk detection is indicated. Comparisons of cigarette smoking, coffee drinking, and alcohol consumption with personality characteristics identified by the MMPI yielded trait clusters associated with each addictive habit. Cigarette smoking and alcohol consumption tended to correlate with traits positively associated with CHD risk. The correlations between those addictive habits and MMPI subtest scores were most significant for the F-scale, which measures inordinate tendencies to exaggerated emotional symptoms, and for the psychopathic deviate and hypomania scales. Significant negative correlations were found between the amount of coffee consumed and those personality traits negatively associated with CHD risk. These negative relationships were most significant for the MMPI scales schizophrenia and psychasthenia. Though the relationships were not necessarily construed to be causal, the contrasting modes through which these drug-associated habits appeared to relate to cardiovascular risk lend some support to the assumption that individuals with various specific sets of personality characteristics tend to incorporate these addictive behaviors into their behavior repertoire in very different ways.